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N00639 AR 000367
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711-000000

TECHNICAL MEMORANDUM

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FROM: Brian Mulhearn and Fred Swan, EnSafe/Allen & Hoshall

DATE: December 16, 1996

RE: Revision 1, Gray Area Lakes, Fish Tissue Sample Results
CTOs - 106 and 094

During the July 24 BRAC Cleanup Team (BCT) meeting, the BCT decided that fish tissue analysis would be conducted at the recreational waterbodies at NSA Memphis. This decision was made because sediment data from the water bodies might not indicate chemical concentrations in sediment below detection limits, possibly resulting in quantifiable tissue levels from bioaccumulation or areas of sediment that were not sampled. For example, these limitations were evident in sediment and fish tissue data collected at SWMU 9 (i.e., Sewage Lagoons).

On August 28 through 30 and September 4 through 6, EnSafe/Allen & Hoshall personnel sampled fish from four Northside waterbodies (Golf Course, Navy, Tanya Lakes and the MWR Pond) using trotlines, rod and reel, and shoreline seining. The target species for these lakes were bass and catfish. Bluegill were also target species at Golf Course Lake in addition to bass and catfish. Samples were eviscerated before sending them to GP Environmental Services, Inc., in Cary, North Carolina, for analyses.

At the end of the sixth day of sampling, sufficient tissue volume and number of species had been collected from each lake for a representative sample to calculate risk. However, target species were not collected from all the lakes due to adverse weather and other factors. Table 1 summarizes analytical results, number and species sampled from each lake, and preparation methods. Table 2 presents corresponding human health risk estimates, which are based on a subsistence fishing scenario. A subsistence scenario assumes a fisherman consumes 54 grams of fish tissue per day, 350 days per year, for 30 years.

Table 1
Tissue Data Summary
NSA Memphis Lake Study
Millington, TN

Lake Sampled	Tissue Type	Preparation Method **	Sample Designation	Reported Chemicals and RBC Exceedances *					
				Dieldrin	RBC = 0.0002	DDD	RBC = 0.0013	DDE	RBC = 0.0093
Golf Course Lake	Catfish	filet only	GLFJ000201	0.032	X	ND		0.011	X
	Bluegill	scaled, edible portions only with skin on	GLFJ000301	0.0025 JP	X	ND		0.0022 J	
	Bluegill	whole fish **	GLFJ000302	0.003 J	X	ND		0.0054 J	
MWR Pond	Catfish	filet only	MWRJ000201	ND		ND		0.0039 J	
Navy Lake	Bass	filet only	NAVJ000101	ND		ND		ND	
	Bluegill	scaled, edible portions only with skin on	NAVJ000301	0.0027 JP	X	0.0019 JP	X	0.011	X
	Crappie	scaled, edible portions only with skin on	NAVJ000401	ND		ND		ND	
Tanya Lake (West)	Bass	filet only	TYWJ000101	ND		ND		ND	

Notes:

- * = All units are mg/kg
- ** = Except for whole fish analysis, organisms were eviscerated the same day they were collected
- ND = Not detected
- X = RBC exceeded
- J = Laboratory estimated the concentration because it is below the detection limit
- P = Concentration was not confirmed by the laboratory's instruments
- The USEPA human health risk based PRE risk threshold is one in ten thousand incidences of cancer. Based on the PRE methods recommended by USEPA, corresponding risk estimates for the chemicals above would be below USEPA's PRE risk threshold, except for catfish in Golf Course Lake. Excess risk from dieldrin in Golf course Lake catfish would be approximately 1.6 in ten thousand (see Table 2), which is slightly greater than USEPA's 1E-4 PRE threshold.

Table 2
Preliminary Risk Evaluation*
NSA Memphis Lake Study
Millington, TN

<i>Lake Sampled</i>	<i>Tissue Type</i>	<i>Sample Designation</i>	<i>Dieldrin</i>	<i>Dieldrin ILCR Based on RBC = 0.0002</i>	<i>DDD</i>	<i>DDD ILCR Based on RBC = 0.0013</i>	<i>DDE</i>	<i>DDE ILCR Based on RBC = 0.0093</i>	<i>SUM ILCR</i>
Golf Course Lake	Catfish	GLFJ000201	0.032	1.60E-04	ND		0.011	1.18E-06	1.61E-04
	Bluegill	GLFJ000301	0.0025 JP	1.25E-05	ND		0.0022 J	2.37E-07	1.27E-05
	Bluegill	GLFJ000302	0.003 J	1.50E-05	ND		0.0054 J	5.81E-07	1.56E-05
MWR Pond	Catfish	MWRJ000201	ND		ND		0.0039 J	4.19E-07	4.19E-07
Navy Lake	Bass	NAVJ000101	ND		ND		ND		
	Bluegill	NAVJ000301	0.0027 JP	1.35E-05	0.0019 JP	1.46E-06	0.011	1.18E-06	1.61E-05
	Crappie	NAVJ000401	ND		ND		ND		
Tanya Lake (West)	Bass	TYWJ000101	ND		ND		ND		

Notes:

RBC Risk-based concentrations for tissue ingestion, obtained from USEPA Region III's 1996 Risk-Based Concentration Table

ILCR Incremental excess lifetime cancer risk

ND Not detected

J = Laboratory estimated the concentration because it is below the detection limit

P = Concentration was not confirmed by the laboratory's instruments

* all tissue concentrations and RBCs are reported in mg/kg

Golf Course Lake

Ten bluegill and one catfish were collected from Golf Course Lake. Bluegill were substituted for bass based on similar trophic level and were divided into two different samples — four bluegill collected August 29, 1996, and six bluegill collected August 28, 1996. The catfish was collected September 6, 1996.

Dieldrin and DDE were reported in both bluegill and catfish tissue sampled from this lake, as shown on Table 1. Risk estimates were compared to USEPA's cumulative upper bound risk threshold of $1E-4$ (USEPA 1994). Table 2 indicates risk below USEPA's $1E-4$ upper bound cumulative risk threshold for bluegill, while the risk estimate for catfish exceeds the cumulative risk threshold. Because dieldrin accounts for most of the risk estimate, risk was estimated for dieldrin based on a recreational fisherman, assuming a 45 kg adolescent consumes 145 grams of fish 39 days per year for 10 years. The exposure frequency of 39 days per year is based on consuming one meal of three out of four weekends per year (i.e., three-fourths of 52 weekends per year). Risk estimates for fish tissue are calculated as follows:

$$ILCR = \frac{(SF)(EPC)(EF)(ED)(IR)}{[(BW)(AT)(1000g/kg)]}$$

Where:

SF	=	Slope factor (16 kg-day/mg)
EPC	=	Exposure point concentration in tissue (0.032 mg/kg)
EF	=	exposure frequency (39 days/year)
ED	=	exposure duration (10 years)
IR	=	Ingestion rate (145 g/day)
BW	=	Body weight (45 kg)
AT	=	Averaging time (25,550 days)
ILCR	=	Incremental excess lifetime cancer risk ($2.5E-5$)

Assuming the hypothetical receptor consumed the same amount of fish more frequently, once each weekend day, or 104 days per year, the ILCR would be approximately $6.7E-5$. Although this is within USEPA's acceptable risk range, continued pesticide application at the golf course could introduce variability in these risk estimates, and it would be prudent to maintain the institutional control of catch and release fishing only at the Golf Course Lakes.

MWR Pond

The MWR Pond seining effort produced two catfish on September 5, 1996 that were prepared as shown on Table 1. Table 2 indicates that the risk estimates do not exceed the cumulative risk threshold.

Navy Lake

Five bass, five bluegill, and three crappie were collected from Navy Lake and were prepared as shown on Table 1. Except for two bass collected August 30, 1996, these samples were collected August 29, 1996. As shown on Table 2, risk estimates do not exceed the cumulative risk threshold for the samples analyzed.

Tanya Lakes (east and west)

The Tanya Lake east collection effort produced no fish, while Tanya Lake west produced one bass on August 29, 1996, which was prepared for analyses as shown in Table 1. The risk estimate for Tanya Lake west bass shown in Table 2 is below the cumulative risk threshold.

Human Health Risk Summary

Except for catfish sampled from Golf Course Lake, risk estimates do not exceed USEPA's upper bound risk threshold of 1-in-10,000. The risk estimate for catfish from Golf Course Lake is based on a subsistence fishing scenario, and fishing is posted "catch and release only." Therefore, this assumption overestimated risk. The risk estimate based on a recreational scenario did not exceed the upper bound risk threshold. Based on the analytical data reported in this technical memorandum and the continuing use of pesticides on and near the NSA Memphis golf course, risk managers should consider maintaining the fishing restriction at Golf Course Lake and monitoring the use of pesticides.

Ecological Risk

After reviewing the fish tissue data, the concentrations present in fish tissue at NSA waterbodies pose minimal risk to wildlife. In fishes, bioaccumulation and biomagnification could be occurring up the food chain based on observed quantifiable tissue levels of dieldrin, DDD, and DDE (Table 1). Wading birds with a diet primarily of fish, such as the Great Blue Heron, Little Green Heron, Night Heron and nonpasserine birds such as the Belted Kingfisher are species of concern due to the potential for bioaccumulation and biomagnification and possible egg shell thinning caused by ingestion of biota exposed to DDT and its degradation products. For risk characterization, an intake model was used to estimate risk for the Belted Kingfisher.

Two endpoints were selected as risk indicators — egg shell thinning (sublethal toxicity) and lethality. Based on the concentrations reported for DDD, DDE, and dieldrin and their associated potential to cause adverse ecological effects, DDE was selected as the indicator chemical for sublethal toxicity using the Lowest Observable Adverse Effect Level (LOAEL) of 0.14 mg/kg based on eggshell thinning (Longcore, 1977). Similarly, dieldrin was used as an indicator for lethality based on the LD₅₀ of 3 mg/kg reported by Hill, et al., 1975. In accordance with the Wildlife Exposure Factors Handbook (USEPA 1993), the LD₅₀ was divided by five to determine the Threshold Risk Value (TRV) used in the model to indicate lethality. Table 3 presents the ecological risk estimates for the Belted Kingfisher.

Table 3
Preliminary Ecological Risk Evaluation*
NSA Memphis Lake Study
Millington, TN

Lake Sampled	Tissue Type	Sample Designation	Lethality**			Sublethal Effects**		
			Dieldrin	TRV (1)	HQ	DDE	TRV (2)	HQ
Golf Course Lake	Catfish	GLFJ000201	0.032	0.6	6.04E-03	0.011	0.14	8.90E-03
	Bluegill	GLFJ000301	0.0025 JP	0.6	4.72E-04	0.0022 J	0.14	1.78E-03
	Bluegill	GLFJ000302	0.003 J	0.6	5.67E-04	0.0054 J	0.14	4.37E-03
MWR Pond	Catfish	MWRJ000201	ND			0.0039 J	0.14	3.16E-03
Navy Lake	Bass	NAVJ000101	ND			ND		
	Bluegill	NAVJ000301	0.0027 JP	0.6	5.10E-04	0.011	0.14	8.90E-03
	Crappie	NAVJ000401	ND			ND		
Tanya Lake (West)	Bass	TYWJ000101	ND			ND		

Notes:

- * = Tissue concentrations and TRVs are reported in mg/kg
- ** = Assuming the Belted Kingfisher as an indicator species
- HQ = Hazard Quotient; an HQ exceeding 1.0 indicates minimal risk; an HQ exceeding 10 indicates moderate risk, and an HQ exceeding 100 indicates extreme risk

Where:

$$HQ = \frac{T \times Ct \times IR}{(BW \times TRV)}$$

- T = Fraction time spent onsite (unitless, assuming 1.0)
- Ct = Concentration in tissue (reported above in mg/kg)
- IR = Ingestion rate (0.017 kg/day from Nagy, 1987)
- BW = Body weight (0.15 kg from USEPA, 1993)
- TRV = Threshold risk value (shown in Table 3 above in mg/kg-day)
- (1) = 0.6 (LD50 of 3 for dieldrin from Hill et al., 1975 divided by 3)
- (2) = LOAEL of 0.14 (Longcore and Stendall, 1977)
- ND = Not detected
- J = Laboratory estimated the concentration because it is below the detection limit
- P = Concentration was not confirmed by the laboratory's instruments
- Lethality = Dieldrin was used as the most conservative indicator chemical for lethal effects
- Sublethal Effect = DDE can cause egg shell thinning; consequently, this was the selected sublethal indicator and endpoint for the reported DDE concentrations

Uncertainty

- Bioaccumulation rates versus exposure time of biota cannot be accurately predicted without knowing the age of the fish.
- The lakes were last stocked in February 1995. It is possible that contaminants found in the sampled fish could be from sources other than NSA Memphis.
- Due to analytical limitations, the possibility exists that wide-spread concentrations of sediment chemicals below the detection limit could result in quantifiable tissue levels through bioaccumulation.
- Other pathways could potentially exist to other wildlife species through dermal contact with contaminated water, soil, sediment, or ingestion of contaminated food, water, or soil.
- Without additional sediment and surface water samples with lower detection limits, ecological risk to aquatic and terrestrial wildlife communities such as snakes, frogs, turtles, raccoon, opossum, deer, and wild turkeys cannot be determined.
- The ingestion model used to determine risk was based on the most conservative numbers and assumptions available. Therefore, the actual HQs may be lower than those predicted in the model.
- Toxicological effects studies may differ at individual versus community levels.
- Extrapolation of literature-generated effect levels to onsite species and communities may not be appropriate.

Ecological Risk Summary

The HQs calculated for the Belted Kingfisher, assumed the kingfisher makes his diet of the most contaminated tissue that was analyzed. Therefore, the intake exposure assumptions overestimated risk. All HQs for each pond are below 1, indicating ecological risks to wading birds are below the minimal risk threshold. Risk to other aquatic and terrestrial species cannot be addressed due to uncertainties in sediment and surface water concentrations and a general lack of data.

References

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